

**WHAT IS CLAIMED IS:**

1. An interface device for interfacing at least a portion of at least one string of batteries with a battery monitoring system, comprising:
  - a) at least one probe means for respectively probing said portion of said at least one string, each of said at least one probe means including:
    - i) a controllable sensing means for sensing a plurality of parameters of the corresponding portion;
    - ii) a communication means for communicating data to and from the controllable sensing means, the data including control signals sent from the battery monitoring system to the controllable sensing means, and information signals relating to the parameters of the corresponding portion that are selected by the control signals; and
    - iii) a memory for memorizing an address assigned to the corresponding probe means upon reception of an initialization signal sent by the battery monitoring system via the communication means; and
  - b) a bus for serially interconnecting the communication means of each of said at least one probe means to the battery monitoring system in a daisy chain manner.
2. An interface device according to claim 1, wherein:
  - a) said communication means includes a multiplexer, an analog to digital converter, controller means for controlling the operation of said probe means and optical insulation means for insulating said communication means from said bus means; and
  - b) said bus is a five wire bus, where a first wire is used exclusively for addressing purposes, a second wire is used as a broadcast in channel, a third wire is used as a broadcast out channel, and a fourth and fifth wires are used for supplying voltage.
3. An interface device according to claim 2, wherein:

- a) said sensing means of said probe includes an AC conditioning section and an analog front end, said analog front end being connected to said battery terminals and to said multiplexer of said communication means.
- 4. An interface device according to claim 1, wherein said probe means are a battery performance probe, and said portion of said string include a positive and negative terminal of a battery, and said probe means are connected to said positive and negative terminals of said battery.
  - 5. An interface device according to claim 1, wherein said probe means are a current probe, and said portion of said string include a shunt resistor, and said probe means are connected to said shunt resistor.
  - 6. An interface device according to claim 1, wherein said probe means are a rectifier voltage probe, and said portion of said string is said string as a whole having a positive and negative terminal, and said probe means are connected to said positive and negative terminals of said string.
  - 7. A battery monitoring system comprising:
    - a) a plurality of batteries connected in series to form at least one string of batteries;
    - b) a plurality of probe means for respectively probing a portion of said at least one string, each of said probe means including:
      - i) a controllable sensing means for sensing a plurality of parameters of the corresponding portion of said at least one string;
      - ii) a communication means for communicating data to and from the controllable sensing means, the data including control signals and information signals relating to the parameters of the corresponding portion of said at least one string that are selected by the control signal;
      - iii) a memory for memorizing an address assigned to the corresponding probe means upon reception of an initialization signal;
      - iv) a bus for serially interconnecting the communication means of each of said at least one probe means in a daisy chain manner; and

- c) a system server connected to said bus and configured to transmit an initialization signal, to receive respective addresses from each of said at least one probe means, to select one of said at least one probe, to transmit control signals to a selected one of said at least one probe and to receive information signals relating to the characteristics of the corresponding portion of said at least one string, memory means for storing said information signals, calculating means for calculating a plurality of values relating to said characteristics and alarm means for raising an alarm when one or more of said values is outside a predetermined range.
- 8. A battery monitoring system according to claim 7, wherein:
  - a) said communication means includes a multiplexer, an analog to digital converter, microprocessor means for controlling the operation of said probe means and optical insulation means for insulating said communication means from said bus means; and
  - b) said bus is a five wire bus, where a first wire is used exclusively for addressing purposes, a second wire is used as a broadcast in channel, a third wire is used as a broadcast out channel, and a fourth and fifth wires are used for supplying voltage.
- 9. A battery monitoring system according to claim 8, wherein:
  - a) said sensing means of said probe includes an AC conditioning section and an analog front end, said analog front end being connected to said portion of said string and to said multiplexer of said communication means.
- 10. A battery monitoring system according to claim 7, wherein said probe means includes at least one battery performance probe.
- 11. A battery monitoring system according to claim 10, wherein said probe means further includes at least one current probe.
- 12. A battery monitoring system according to claim 10, wherein said probe means further includes at least one rectifier voltage probe.

13. A battery monitoring system comprising:

- a) a plurality of batteries connected in series to form at least one string of batteries;
- b) a plurality of probe means for respectively probing one at least a portion of said at least one string, each of said probe means including:
  - i) a controllable sensing means for sensing a plurality of parameters of the corresponding portion;
  - ii) a communication means for communicating data to and from the controllable sensing means, the data including control signals and information signals relating to the parameters of the corresponding portion that are selected by the control signal;
  - iii) a bus for serially interconnecting the communication means of each of said at least one probe means in a daisy chain manner;
- c) at least one current injection means connected to said at least one string for injecting a current in said at least one string upon receipt of a control signal; and
- d) a system server connected to said bus and configured to select one of said at least one probe means, to transmit control signals to a selected one of said at least one probe means and to receive information signals relating to the characteristics of the corresponding portion, memory means for storing said information signals, calculating means for calculating a plurality of values relating to said characteristics and alarm means for raising an alarm when one or more of said values is outside a predetermined range, said system server being operatively connected to said at least one current injection means for sending a control signal to said current injection means to inject a current in said at least one string.

14. A battery monitoring system according to claim 13, wherein said current that is injected by said current injection means is an AC current.

15. A battery monitoring system according to claim 13, wherein said at least one probe means includes at least one battery performance probe.

16. A battery monitoring system according to claim 15, wherein said at least one probe means further includes a current probe for each of said at least one string.

17. A battery monitoring system according to claim 16, wherein said at least one probe means further includes a rectifier voltage probe for each of said at least one string.

18. A method of initializing a plurality of probes in a battery monitoring system, the battery monitoring system including:

- a) a plurality of batteries connected in series to form at least one string of batteries;
- b) a plurality of probe means for respectively probing one of said plurality of batteries, each of said probe means including:
  - i) a controllable sensing means for sensing a plurality of parameters of the corresponding battery;
  - ii) a communication means for communicating data to and from the controllable sensing means, the data including control signals and information signals relating to the parameters of the corresponding battery that are selected by the control signal;
  - iii) a memory for memorizing an address assigned to the corresponding battery upon reception of an initialization signal;
  - iv) a bus for serially interconnecting the communication means of each of said at least one probe means in a daisy chain manner; and
- c) a system server connected to said bus and configured to transmit an initialization signal, to receive respective addresses from each of said at least one probe means, to select one of said at least one probe, to transmit control signals to a selected one of said at least one probe, and to receive information signals relating to the characteristics of the corresponding battery, memory means for storing said information signals, calculating means for calculating a plurality of values relating to said characteristics and alarm means for raising an alarm when one or more of said values is outside a predetermined range;

the method comprising the steps of:

- a) sending an initialize request on the bus means to all probes so that all probes erase their present address and set themselves in listen mode;
- b) for each probe in each string:
  - i) selecting a probe by setting a low voltage on a probe select line;

- ii) sending from said probe to the server an active state confirmation;
  - iii) sending an address to the said probe;
  - iv) registering said address in said probe and acknowledging said registration;
  - v) upon receipt of said acknowledgement, sending a signal to said probe to deselect itself and select the next probe in the chain; and
- c) performing each of said steps i) to v) for each of said probes in each of said strings.

19. A method for measuring the impedance of a plurality of batteries connected in series to form at least one string of batteries, each of said batteries being provided with probe means for measuring the voltage across each of said batteries respectively, the method comprising the steps of:

- a) providing a current injection means for each of said at least one string of batteries;
- b) injecting a current in each of said strings;
- c) measuring the voltage across each of said batteries;
- d) calculating the impedance of each of said batteries by dividing said voltage by said current for each of said batteries.

20. A method according to claim 19 wherein said step of injecting a current in each of said strings includes the step of injecting an AC current.